Repeated Measures ANOVA Length Frequency

Alex J. Benecke

February 9, 2018

PSD-X 2013 - 2016 CPUE

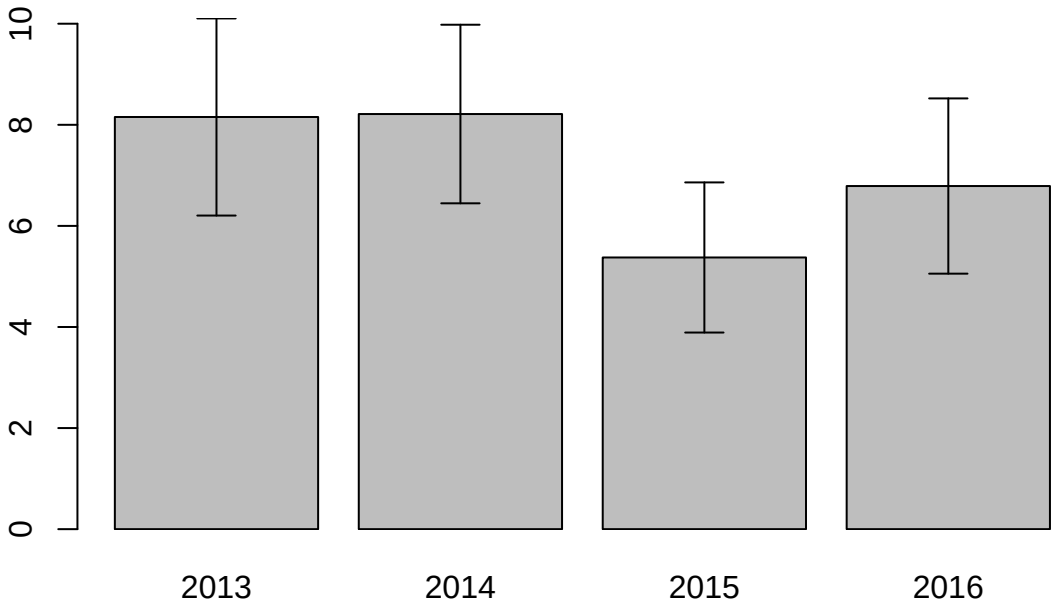
```
cpe <- read.csv("Data/Clean-Data/CPUE-gcat_2013-2016.csv") %>%
  filterD(Species == 317) %>%
  filterD(gcat != "substock") %>%
  filterD(!is.na(gcat))

headtail(cpe)
```

```
##     Year Site    effort Species      gcat caught   cpe.hr
## 1   2013    2 0.2536111     317     stock      7 27.60131
## 2   2013    2 0.2536111     317   quality      6 23.65827
## 3   2013    2 0.2536111     317 preferred      0  0.00000
## 208 2016   19 0.2322222     317 preferred      0  0.00000
## 209 2016   19 0.2322222     317 memorable      0  0.00000
## 210 2016   19 0.2322222     317    trophy      0  0.00000
```

```
str(cpe)
```

```
## 'data.frame':    210 obs. of  7 variables:
##  $ Year   : int  2013 2013 2013 2013 2013 2013 2013 2013 2013 2013 ...
##  $ Site   : int  2 2 2 2 2 4 4 4 4 4 ...
##  $ effort : num  0.254 0.254 0.254 0.254 0.254 ...
##  $ Species: int  317 317 317 317 317 317 317 317 317 317 ...
##  $ gcat   : Factor w/ 5 levels "memorable","preferred",..: 4 3 2 1 5 4 3 2 1 5 ...
##  $ caught : int  7 6 0 0 0 9 7 0 0 0 ...
##  $ cpe.hr : num  27.6 23.7 0 0 0 ...
```

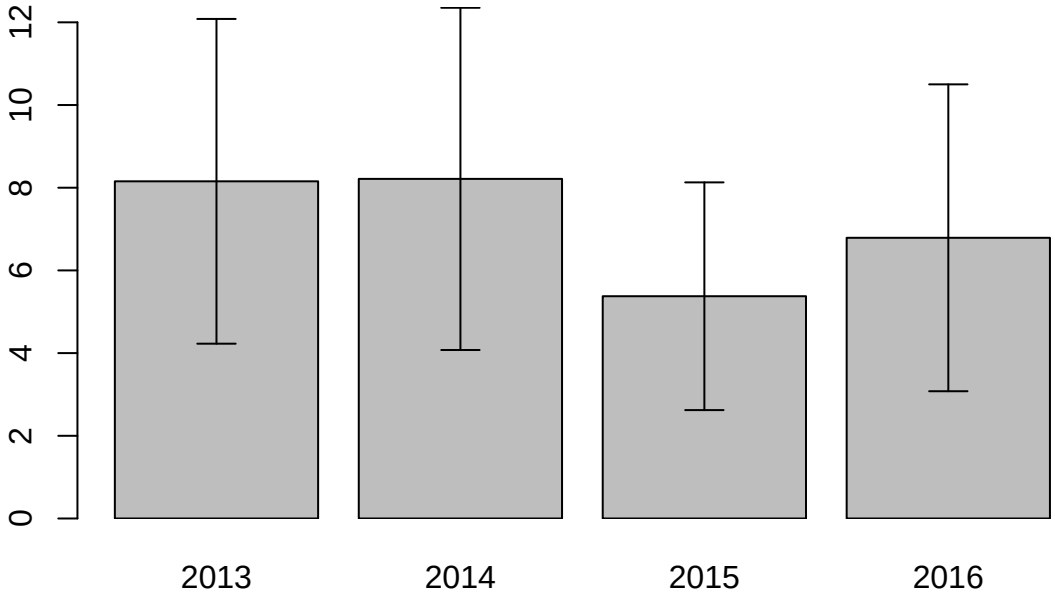
```
bargraph.CI(cpe$Year, cpe$cpe.hr)
```




```
cpe2 <- aggregate(cpe.hr ~ Year + gcat, data = cpe, FUN = mean)

cpe2
```

```
##    Year      gcat    cpe.hr
## 1  2013 memorable  0.000000
## 2  2014 memorable  0.000000
## 3  2015 memorable  0.000000
## 4  2016 memorable  0.000000
## 5  2013 preferred  5.986703
## 6  2014 preferred  4.938368
## 7  2015 preferred  6.201574
## 8  2016 preferred  2.419355
## 9  2013   quality 17.259044
## 10 2014   quality 16.879829
## 11 2015   quality 15.024400
## 12 2016   quality 14.509571
## 13 2013     stock 17.527035
## 14 2014     stock 19.249018
## 15 2015     stock  5.650490
## 16 2016     stock 17.013989
## 17 2013    trophy  0.000000
## 18 2014    trophy  0.000000
## 19 2015    trophy  0.000000
## 20 2016    trophy  0.000000
```

```
bargraph.CI(cpe2$Year, cpe2$cpe.hr)
```



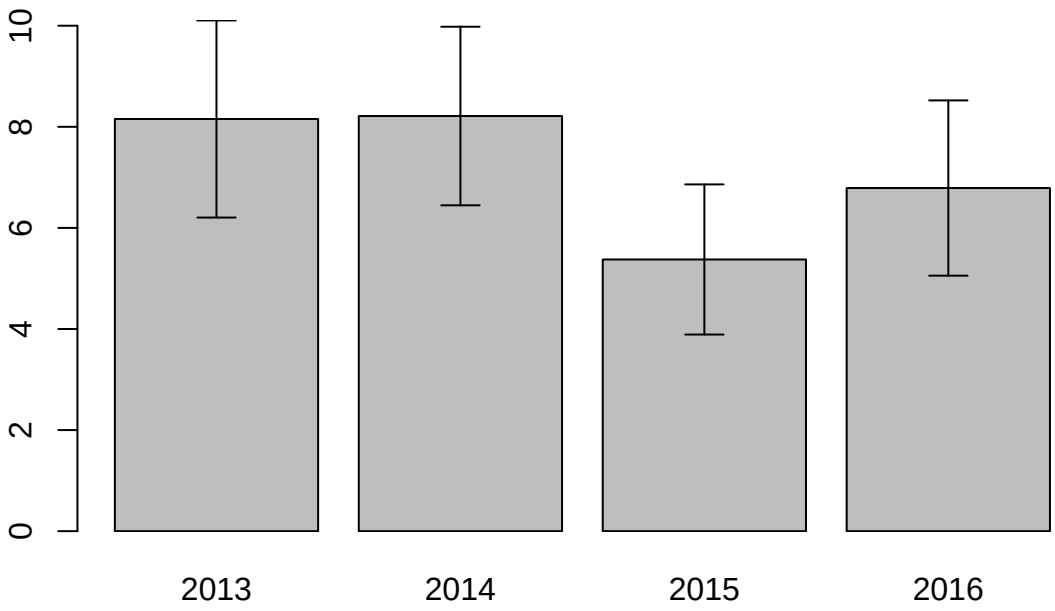

```
levels(cpe$gcat)
```

```
## [1] "memorable" "preferred" "quality"   "stock"     "trophy"
```

```
cpe %<>% mutate(gcatQ=mapvalues(gcat,
                                from=c("stock","quality","preferred", "memorable", "trophy"),
                                to=c("quality-", "quality+", "quality+", "quality+", "quality+")),
                gcatQ=droplevels(gcatQ))

headtail(cpe)
```

```
##     Year Site    effort Species      gcat caught   cpe.hr    gcatQ
## 1   2013    2 0.2536111     317     stock      7 27.60131 quality-
## 2   2013    2 0.2536111     317   quality      6 23.65827 quality+
## 3   2013    2 0.2536111     317 preferred      0  0.00000 quality+
## 208 2016   19 0.2322222     317 preferred      0  0.00000 quality+
## 209 2016   19 0.2322222     317 memorable      0  0.00000 quality+
## 210 2016   19 0.2322222     317    trophy      0  0.00000 quality+
```

```
bargraph.CI(cpe$Year, cpe$cpe.hr)
```




```
aov1 <- aov(cpe.hr~gcatQ+Year,data = cpe)

summary(aov1)
```

```
##              Df Sum Sq Mean Sq F value   Pr(>F)
## gcatQ         1   3298    3298  22.839 3.34e-06 ***
## Year          1    114     114   0.786    0.376
## Residuals   207  29887     144
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

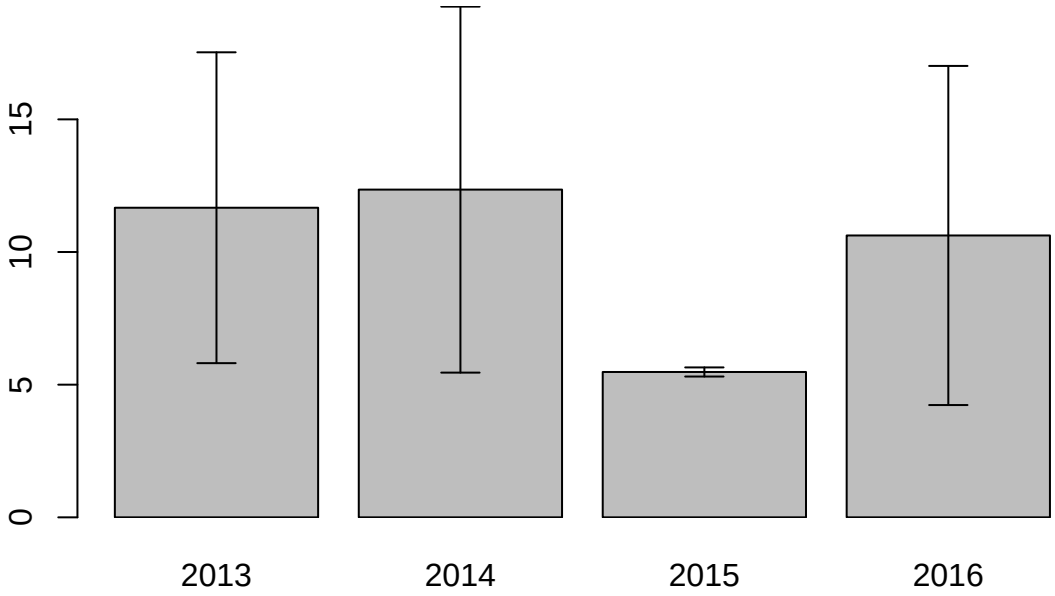
```
cpe3 <- aggregate(cpe.hr ~ Year + gcatQ, data = cpe, FUN = mean)

cpe3
```

```
##   Year    gcatQ    cpe.hr
## 1 2013 quality+  5.811437
## 2 2014 quality+  5.454549
## 3 2015 quality+  5.306494
## 4 2016 quality+  4.232231
## 5 2013 quality- 17.527035
## 6 2014 quality- 19.249018
## 7 2015 quality-  5.650490
## 8 2016 quality- 17.013989
```

```
aov2 <- aov(cpe.hr~gcatQ+Year,data = cpe3)

summary(aov2)
```

```
##             Df Sum Sq Mean Sq F value Pr(>F)
## gcatQ        1 186.59  186.59   8.703 0.0319 *
## Year         1  10.02   10.02   0.468 0.5245
## Residuals    5 107.19   21.44
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
bargraph.CI(cpe3$Year, cpe3$cpe.hr)
```




```
library(nlme)
```

```
##
## Attaching package: 'nlme'
```

```
## The following object is masked from 'package:dplyr':
##
##     collapse
```

```
headtail(cpe)
```

```
##     Year Site    effort Species      gcat caught   cpe.hr    gcatQ
## 1   2013    2 0.2536111     317     stock      7 27.60131 quality-
## 2   2013    2 0.2536111     317   quality      6 23.65827 quality+
## 3   2013    2 0.2536111     317 preferred      0  0.00000 quality+
## 208 2016   19 0.2322222     317 preferred      0  0.00000 quality+
## 209 2016   19 0.2322222     317 memorable      0  0.00000 quality+
## 210 2016   19 0.2322222     317    trophy      0  0.00000 quality+
```

```
lme1 <- lme(cpe.hr~gcatQ, data = cpe, random = ~1 | Year)

summary(lme1)
```

```
## Linear mixed-effects model fit by REML
##  Data: cpe
##        AIC      BIC    logLik
##   1641.196 1654.546 -816.5979
##
## Random effects:
##  Formula: ~1 | Year
##          (Intercept) Residual
## StdDev: 0.0006779333 12.00965
##
## Fixed effects: cpe.hr ~ gcatQ
##                 Value Std.Error  DF  t-value p-value
```

```
## (Intercept)   5.138043  0.926565 205 5.545259       0
## gcatQquality- 9.906654  2.071862 205 4.781522       0
##  Correlation:
##               (Intr)
## gcatQquality- -0.447
##
## Standardized Within-Group Residuals:
##        Min         Q1        Med         Q3        Max
## -1.2527169 -0.4278261 -0.4278261  0.1675928  5.2425994
##
## Number of Observations: 210
## Number of Groups: 4
```

```
XvY <- ifelse(cpe$gcat=="quality",1,0) +
  ifelse(cpe$gcat=="preferred",1,0) +
  ifelse(cpe$gcat=="memorable",1,0) +
  ifelse(cpe$gcat=="trophy",1,0) +
  ifelse(cpe$gcat=="stock",-1,0)

XvY
```

```
##   [1] -1  1  1  1  1 -1  1  1  1  1 -1  1  1  1  1 -1  1  1  1  1 -1  1  1
##  [24]  1  1 -1  1  1  1  1 -1  1  1  1  1 -1  1  1  1  1 -1  1  1  1  1 -1
##  [47]  1  1  1  1 -1  1  1  1  1 -1  1  1  1  1 -1  1  1  1  1 -1  1  1  1
##  [70]  1 -1  1  1  1  1 -1  1  1  1  1 -1  1  1  1  1 -1  1  1  1  1 -1  1
##  [93]  1  1  1 -1  1  1  1  1 -1  1  1  1  1  1  1 -1  1  1  1 -1  1  1  1
## [116] -1  1  1  1  1 -1  1  1  1  1 -1  1  1  1  1  1  1 -1  1  1  1  1 -1
## [139]  1  1  1  1 -1  1  1 -1  1  1  1  1 -1  1  1  1  1 -1  1  1  1  1 -1
## [162]  1  1  1  1 -1  1  1  1  1  1 -1  1  1  1 -1  1  1  1  1  1 -1  1  1
## [185]  1 -1  1  1  1  1 -1  1  1  1  1 -1  1  1  1  1 -1  1  1  1  1 -1  1
## [208]  1  1  1
```

```
lme2 <- lme(cpe.hr~XvY, data = cpe, random = ~1 | Year)

summary(lme2)
```

```
## Linear mixed-effects model fit by REML
##  Data: cpe
##        AIC      BIC   logLik
##   1642.582 1655.932 -817.291
##
## Random effects:
##  Formula: ~1 | Year
##          (Intercept) Residual
## StdDev: 0.0006781789 12.00965
##
## Fixed effects: cpe.hr ~ XvY
##                 Value Std.Error  DF   t-value p-value
## (Intercept) 10.091370  1.035931 205  9.741352       0
## XvY         -4.953327  1.035931 205 -4.781522       0
##  Correlation:
##     (Intr)
## XvY -0.6
##
## Standardized Within-Group Residuals:
##        Min         Q1        Med         Q3        Max
```

```
## -1.2527169 -0.4278261 -0.4278261  0.1675928  5.2425994
##
## Number of Observations: 210
## Number of Groups: 4
```